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(J McF.)

Pathology, Diagnosis and Treatment
of Perforation of the
Appendix Vermiformis.

BY

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*Read in the Section on Surgery at the Thirty-Eighth Annual
Meeting of the American Medical Association, June, 1887.*

*Reprinted from the Journal of the American Medical
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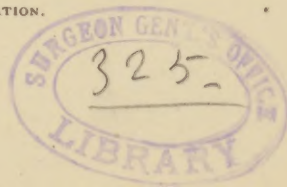
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PATHOLOGY, DIAGNOSIS AND TREATMENT OF PERFORATION OF THE APPENDIX VERMIFORMIS.

Lest the title of my paper should lead to the impression that I have made observations of a practical nature on this grave condition, calculated to serve as a guide to the practitioner, let me announce at the outset that my inquiry is directed to the discussing of means for the clearing away of the doubts that cluster around perforation of the vermiform appendage.

It is highly probable that many of the cases which run the ordinary course of typhlitis may originate in a slight yielding of the coats of the appendix, that allows an exudation of its contents and sets up a local inflammation in the neighboring tissues, with a shutting in of the pus by adhesive inflammation between the serous membranes around. Such cases having the effects confined to a limited area of the abdominal cavity do not present the phenomena of general peritonitis, but retain the characteristics of a circumscribed inflammation.

Having treated of the "Surgical Relations of the Ileo-cæcal Region" in a paper laid before this body at its last meeting, and having contributed a paper on the "Surgery of the Ileo-cæcal Connections" to the October, 1886, number of *Gaillard's Medical Journal*, I must presume upon an acquaintance with the points therein presented. My attention will therefore be confined to the peculiar phenomena connected with perforation of the vermiform appendage, so far as they are capable of being considered separately from other forms of intestinal perforation, and peritoneal inflammation from other causes.

The anatomical seat of the disorder is so definitely fixed in its commencement, that it would seem a simple matter to diagnosticate the origin of the symptoms; yet practically it proves a most difficult thing to differentiate the train of disorders associated with this accident from those troubles growing out of derangements in the ileo-cæcal region from other causes. The sympathetic disturbance in the abdominal viscera from local lesions are very obscure, and it is observed that in strangulated hernia, for instance, the pain is not located at the constriction but at the umbilicus. In the case of strangulated inguinal hernia for which Dr. N. B. Carson practiced resection successfully, it is stated, that "while skating, the patient was suddenly seized with a severe pain in the abdomen, which he did not locate definitely." Other instances might be cited in illustration of the absence of local symptoms in acute cases of obstruction of the bowels; and the history of the local origin of general peritonitis from perforation of the intestines, rarely presents an indication of the point at which it has occurred. The same is observed in the early manifestations from perforation of the appendix. Dr. J. D. Bryant's fatal case of perforation of the vermiform appendix, exhibits strikingly the want of those local symptoms which might serve as a guide to the nature of the trouble at the outset. He states that the patient has been suddenly attacked with a moderately severe griping pain in the epigastric region. He noticed no pain or tenderness in the right iliac region. About fifteen hours afterward, the pain became more severe than at the outset, and was still located in the epigastric region. The tenderness on pressure was general, but was best marked, however, at the lower portion of the abdomen. No isolated point of extra tenderness was discovered. All pain was referred to the epigastric region, the same as at the outset of the attack.

In the case reported by Dr. Tiffany and in two of my own cases there has been a feature which has not been noted by others so far as I have observed, the pain in the privates. If it should turn out that this is present in any considerable proportion of the cases of perforation of the vermiform appendage, it would prove an important element in the diagnosis. It is difficult to trace any sympathy between the inflammatory process which accompanies the exudation from this particular locality, and the genital organs; nor does it appear that there is any influence that could be operative in perforation of the appendix rather than in typhlitis. But the fact of pain in a marked degree being present in these three cases, which were verified as cases of perforation of the appendix, stands forth as an indication which may lead to some practical inference in making up the differential diagnosis of this condition. It is desirable that other observers should direct their attention to this point in the early stage of trouble in the cæcal region, and report upon its presence or absence when the subsequent progress of the cases confirms the reality of this affection.

This occurrence would seem to be more frequent in later years, if the fact of its existence formerly has not been overlooked in its effects being confounded with peritonitis from other local lesions. It is evident that some of the cases are only brought to light upon a necropsy being instituted, and the profession now very properly insists on such examinations in obscure cases. Unfortunately, the people are not educated up to the point of assenting to a proposition by the medical attendant to open up a body for the good of others and the promotion of science; and we often have difficulties to encounter in securing a post-mortem examination of a patient. But perseverance will generally be rewarded by the consent of friends having a fair measure of intelligence; and the insuperable prejudices of ignorant

people can sometimes be set aside by using means of preventing decomposition along with the exploration under the plea of embalming the body. It is, at the present stage of the history of abdominal disorders, so important to make autopsies in obscure cases, that I would urge upon the profession accurate record of every symptom in cases of suspected perforation of the vermiform appendage, and in fatal cases all the details of the post-mortem observations.

I had an opportunity recently of making post-mortem examinations in two cases of perforation of the appendix; which were reported in the *Medical and Surgical Reporter*, of February 5 and April 20, 1887. In both of these patients the symptoms indicated trouble in the ileo-cæcal region at an early period, but the location of the pain and tenderness on pressure was not limited in such form as to indicate the origin of the inflammation; and I am forcibly impressed with the difficulties attending any precise diagnosis of perforation of the appendix vermiformis before the disease has progressed so far as to render operative measures of little avail. The double process of cutting down in the iliac region, and subsequently resorting to laparotomy, for the relief of cases attended with general peritonitis, has not been attended with satisfactory results, so that it behooves us, if possible, to go over the whole ground anew to discover some criterion for our guidance in such cases. An occurrence of inflammation in the tissues of the cæcum, constituting typhlitis, from some accumulation within its cavity, may be relieved by evacuating its contents; and thus terminate by resolution; but it is very rare, if ever, that extravasation of fæcal matter in ulceration of the cæcum is not followed by a discharge in one or another direction. It is therefore recognized by those of most practical experience as proper, at an early stage of inflammatory development in the vicinity of the cæcum, to make an exploratory puncture, to ascertain if there be any deep-

seated focus of pus; and in the event such source of trouble is detected, a free incision, communicating with the hidden septic seat, is warranted.

It is impracticable to determine the exact source of the suppuration, even when the opening at the bottom of this wound is large enough to admit the index finger for the purpose of exploration; and as a consequence the surgeon cannot decide, generally, whether the lesion is in the cæcum or appendix, when the faecal odor leads to the unmistakable inference of the escape of the intestinal contents. As a rule, based upon the anatomical relations of the serous investment of these parts, any discharge through a perforation in either enters the peritoneum; and yet, by adhesive inflammation, may be confined to the immediate proximity of its escape, and hence produce a circumscribed abscess there. On the other hand, when perforation of the vermiform appendix occurs, and the contents become diffused to a greater or less extent in the peritoneal cavity, the inflammatory action extends and constitutes general peritonitis with all its serious consequences; or may be partial, from limitation by the surrounding adhesions between different layers of the peritoneum.

We must seek an explanation of the train of disorders following perforation of the appendix in the irritating quality of the discharge from the opening, whether this be caused by the disintegration of tissue from a localized ulceration of the walls, or from the mechanical pressure of some foreign body or concretion within, which cuts its way through the structure into the peritoneum.

There is present in the appendix at all times either fluid or solid faecal matter, which escapes whenever an outlet exists, and though the quantity may be small at the outset, it gradually increases, so as to permeate in different directions; and being a toxic irritant, it sets up inflammation wherever it comes in contact with the delicate serous membrane, and ulti-

mately induces destruction of its vitality, so that it breaks down in a necrosed state. This brings about the ordinary results of typhlitis, perityphlitis, paratyphlitis or general peritonitis, and the object of the surgeon is to arrest its progress at a point least detrimental to the patient.

The propositions I would submit for consideration are: *first*, the impracticability of making a differential diagnosis between perforation of the walls of the cæcum and those of the appendix; and *second*, that the treatment in its preliminary steps is very similar; so that the operative procedure does not imply a knowledge of which is involved in the given case in advance of its adoption.

The pathological modifications of the tissues in contact with the exudations from either must be identical, on the principle that like causes produce like effects, and the extent of such structural changes depends upon the area involved in the permeation by septic matter. It is a well ascertained fact that the contact of faecal matter with any of the tissues of the body other than the mucous surface with which it is brought into close relations in passing through the intestines, causes rapid disintegration of structure, and propagates a hurtful influence to all the adjacent tissues, with a general depression of the vital powers.

A concise and yet comprehensive paper by Professor Beck, of University College, London, in Heath's "Dictionary of Practical Surgery," gives the characteristics accompanying perforation of the appendix vermiformis so satisfactorily that I will avail myself of it for a general outline of its concomitants.

Perforation of the vermiform appendix is most commonly caused by the presence of a concretion or foreign body within it. According to Dr. Fenwick, who has collected and analyzed 129 published cases, amongst those in which the nature of the ob-

structing body is recorded 28 were concretions, 14 hardened faeces, and 5 foreign bodies. Amongst the cases in which no concretion was found, tubercular ulceration seems to have been the most common cause of perforation, and a few occurred during or after typhoid fever. Concretions are most common in males under 20 years of age. In my two fatal cases referred to already, one, in a gentleman about 32 years old, resulted from a bean becoming impacted in the appendix immediately below its attachment to the cæcum. The other, in a youth 10 years old, was caused by an oblong pointed faecal concretion located about the middle of the appendix.

The effects produced by perforation of the vermiform appendix vary with the anatomical relations of the part and the seat of the ulceration. According to Mr. F. Treves the appendix commonly lies behind the end of the ileum and its mesentery, and is directed upwards and towards the left. In the only other common position it ascends vertically behind the cæcum. It may, however, be so placed that its free end lies at the brim of the pelvis. If perforation takes place near the attached end, or if the whole tube lies behind the cæcum, the abscess would be in the same situation as that resulting from diseases of the cæcum, and would be indistinguishable from it. When the appendix occupies its more common situation, and when the perforation occurs in the free part, it is followed either by general peritonitis, usually fatal under a week, or by the formation of a collection of pus enclosed in a cavity formed by the surrounding coils of intestines firmly united to each other by adhesions. According to Dr. S. Fenwick in 95 cases of which accurate details could be obtained, 38 presented localized collections of pus.

Premonitory symptoms may be entirely wanting, but occasionally there is a history of obscure pains in the right iliac fossa or of periodic attacks indistinguishable from ordinary typhlitis.

In the cases in which perforation is followed by diffuse peritonitis, there is usually a sudden invasion, often during some violent exertion. The pain commences in the right iliac fossa, but soon extends to the whole abdomen. There is constipation, distension of the abdomen, and absence of evident movement of the intestines. The abdomen is tender, but most markedly in the right iliac fossa, when some fullness may be felt. The symptoms are much less severe than those of perforation of the stomach or other parts of the intestines, as the extension of the inflammation is less rapid, owing to the absence of the abundant extravasation of the intestinal contents. For the same reason collapse is not marked. Vomiting, often of dark colored matter, is a marked symptom, as in all other forms of peritonitis.

The symptoms of perforation with localized peritonitis are much more obscure. The invasion is usually somewhat sudden. There are localized pain and tenderness in the right iliac fossa. The pain resembles colic in character. There is usually constipation, but it may alternate with diarrhoea. Vomiting is commonly present. After a day or two an irregular, diffused, elastic swelling may be felt in the right iliac region. At this time rigors are not uncommon, with temperature 103° to 104° , accompanying septicæmia. General peritonitis with intense injection of the serous membrane, and adhesions of recent date between the different coils of intestines and the parietes of the abdomen exist. Purulent fluid may be found localized by surrounding adhesions, or diffused in the peritoneal cavity.

In the diffuse form the diagnosis from other forms of perforative peritonitis can only be made by the comparative absence of collapse, by the commencement of the pain in the right iliac fossa, by the tenderness in that region, and by the somewhat gradual extension of the inflammation to the peritoneum generally. The localized form most closely resembles

simple typhlitis, and sometimes can hardly be distinguished with certainty. As a rule the swelling is more diffused and more acutely tender at an early period than in simple typhlitis, and the constitutional symptoms are much more marked, (Heath's Dictionary of Practical Surgery).

An exploratory operation to discern the source of the disorder, or a post-mortem examination, are the only means of reaching a definite conclusion as to the precise nature of the case, and if we would avoid the latter the former must be resorted to at an early period.

Until recently patients suffering from perforation of the vermiform appendix were practically left to die under the soothing influence of opium, when their end was not hastened by purgatives, enemata, and other violent measures. There is, however, no doubt that whenever perforation takes place the only chance of life lies in opening the abdomen early and freely draining the cavity. This is applicable to those cases in which there is general peritonitis, and still more so to those in which the mischief is localized, whenever a diagnosis can be made.

The incision should as a rule be made above the outer part of Poupart's ligament, and should be about three inches in length. The muscles should be carefully divided and the peritoneum freely opened. The vermiform appendix should then be sought for, and, if it be found and is evidently diseased it may be ligatured with catgut and cut away. If there is diffused peritonitis, with purulent fluid amongst the coils of the intestines, an attempt may be made to clean the cavity by means of sponges squeezed as dry as possible, after being soaked in some antiseptic solution, such as carbolic acid (1:40) corrosive sublimate (1:500) or tincture of iodine (f3ij to Oj). If the pus is distinctly localized in a cavity, it is better not to attempt to clean it out, for fear of breaking down the surrounding adhesions. After

the operation a large drainage tube should be inserted and the wound closed as far as possible by sutures. The operation should be performed with antiseptic precautions, and some antiseptic dressing be applied. (Heath's Dictionary of Medical Surgery.)

It may be necessary in some cases to modify the incision. Should the swelling be situated near the middle line, Professor Beck says the abdomen might be opened at the outer border of the rectus muscle, but care must then be taken not to wound the epigastric artery. He erroneously claims that the middle line can seldom be a suitable situation for the incision, as, being so far removed from the seat of the disease, the drainage would not be efficient. All who have had practical experience in laparotomy for inflammatory affections will doubtless differ with him in this, as the linea alba is now generally preferred for the incision; and by carrying it to a sufficient extent no difficulty is found in reaching any part, and in effecting drainage satisfactorily. It devolves upon the operator likewise to resort to copious irrigation, with or without antiseptics, to remove all purulent collections from the cavity.

In the debate upon penetrating wounds of the abdomen at St Louis I adverted to a simple process for detecting the presence of faecal matter or blood in punctured or gun-shot wounds, which is applicable for an explanatory operation in cases of suspected perforation of the vermiform appendix. The report of my remarks will be found on page 596 of THE JOURNAL of November 27, 1886. They may be summarized by stating that the doubt as to existing lesions of the intestinal canal may be resolved usually by passing two tubes through an opening in the abdominal wall at the site of the injury, both being of a length to reach throughout the cavity, with the outer end of one free and open, while the other is joined to a Davidson syringe. The drainage tube should be fenestrated for some inches from the extremity that

is within the abdomen, and the other end left entire outside to carry off the fluid injected, with whatever admixture it may contain, whether sanguineous, faecal, or purulent. A solution of common salt at a temperature of 100° F., may be thrown into the peritoneal cavity continuously, and allowed to pass out by the escape tube, until the water returns free from the abnormal ingredients therein contained. If the outer termination of the syringe be then secured to the fenestrated tube, while the other is removed from the cavity, suction will remove the remaining fluid. I am impressed with the advantages likely to be derived in diagnosing the conditions resulting from perforation of the vermiform appendix first by aspiration, and subsequently by the process of irrigation here described, as it is evident that a flexible tube may reach accumulations not accessible to the straight or curved metallic tube ordinarily used with an aspirator. The puncture made in aspirating would not suffice for the insertion of a tube, and it would therefore be requisite to make such an incision as to admit a single tube if suction only was indicated, or two tubes if irrigation was intended. This incision should be no larger than necessary, and ought to be made in that part where the supposed exudation or suppuration could be reached most directly. Such a proceeding is called for in the first instance as a means of diagnosis, but may become afterwards an important measure of treatment when a diffused inflammation in the abdominal cavity coexists with local conditions requiring the standard operation by an incision in the iliac regions. Thus the grave complications of following the ordinary procedure in cases of typhilitis by abdominal section may be averted, and the prospect of a favorable issue enhanced.

The adoption of prompt and efficient operative measures in the early stages of that inflammation which is set up by perforations of the vermiform ap-

pendix depends upon a recognition of the conditions at the outset, and a resort to the exploring needle or the aspirator directly through the tissues involved is warranted by the practical result of those who have had the most satisfactory results in treating this class of cases, as well as in the various modifications of typhlitis. If there is one thing more than another that is pressed upon our attention by the recent developments in abdominal surgery it is that delays are dangerous, and we must take time by the forelock if anything is to be accomplished in snatching from the jaws of death a patient who is suffering from perforation of the vermiform appendix. I am so convinced of the urgent demand for surgical interference at the very earliest practicable period after the occurrence of this accident, that even in a case of simple typhlitis with symptoms causing no misgivings as to perforation, it strikes me forcibly that any cautious surgeon would be authorized in cutting down above Poupart's ligament to verify the true state of the deep seated structures. If no lesion is found in either the cæcum or vermiform appendix, no serious trouble is likely to follow such incision, but on the contrary the drainage effected from the immediate neighborhood of the tissues involved in inflammation must prove beneficial, and the history of early incisions where pus has not been discovered encourages the surgeon to adopt this practice.

Should it appear, on the other hand, that a perforation, however slight, exists either in the cæcum or vermiform appendix, the recourse to Lembert's suture for lesions of the cæcum, and of excision with ligation in perforations of the appendix, afford the best prospect of staying the progress of disorganization. A thorough cleansing of the adjoining tissues by antiseptic washes, avoiding the solutions of bichloride of mercury, is likely to correct the disintegrating process set up by the septic contamination; and by the continuous use of iodoform with the

dressings of absorbent cotton, a reasonable calculation may be made of saving the patient. It is not incumbent upon the surgeon to wait for a certainty of perforation—but when a just ground of apprehension exists, he should operate and give his patient the benefit of the doubt.

The practical deductions from this inquiry in regard to the concomitants of perforation of the appendix vermiformis may be included under the following heads:

1. The primary disorder is dependent upon a local irritant, either mechanical, chemical or vital, inducing ulceration and disintegration at some point in its walls.

2. The modification in the tissues of adjacent parts depends upon the presence of a toxic exudation from its cavity, that ultimately leads to disorganization of structure.

3. Extension of the degenerating process depends upon the permeation of the structures with the faecal matter, but may result from suppuration, or the automatic propagation of inflammation from one part to another.

4. Agglutination between the layers of peritoneum may shut in purulent accumulations, and thus limit the inflammatory action to a circumscribed area, so as to assume the nature of an abscess in that locality.

5. General peritonitis may be accompanied by extensive adhesions of the adjacent serous membranes, and followed by vital prostration and collapse, calling for the knife.

6. Septicæmia may occur from absorption of septic matter independent of suppuration, and associated with a low form of fever which ought to be treated by antiseptics and irrigation of the abdominal cavity by hot water.

7. When there are sufficient indications of perforation in the general symptoms, with pain and tender-

ness on pressure over the cæcal region, without signs of fluctuation, an exploratory puncture below the ileo-cæcal junction is warranted.

8. If there are any reasonable grounds to believe that pus is present, or that there is extravasation of fæcal matter, whether from the perforation of the cæcum or appendix, a free incision above Poupart's ligament should be carried down to those parts and drainage kept up afterwards.

9. In perforation of the appendix associated with general peritonitis an incision in the linea alba affords the best prospect of reaching all the parts involved, and should be accompanied by thorough cleansing of the abdominal cavity and especially of the ileo cæcal region.

10. The most efficient means of closing an opening in the cæcum is by Lembert's suture, while an opening in the appendix demands excision and ligation.

11. When perforation is suspected, washing out the abdomen by the use of a syringe and two tubes will assist in the diagnosis and treatment.

12. An early operation with a doubtful diagnosis of perforation of the appendix lessens the likelihood for a confirmation of it by a necropsy, and hence no time should be lost in awaiting developments.

